

DOINGWHATWORKS



Presentation

FULL DETAILS AND TRANSCRIPT

Preparing Students for Success in Algebra

June 2008

Topic: National Math Panel: Critical Foundations for Algebra
Practice: Mathematics Preparation for Algebra

Highlights

- The mathematics staff from the New Rivers Elementary and Middle schools hold their first K-12 meeting to discuss mathematical vertical alignment across the grades and student assessment outcomes
- Preparing elementary and middle school students for later success in algebra
- Establishing a focused and coherent mathematics curriculum that follows a logical progression of the most important skills and topics
- Developing proficiency through understanding key concepts, mastering basic math facts, using standard algorithms, and solving problems
- Explanations of the critical foundation of algebra—fluency with whole numbers, proficiency with fractions, and solid grasp of particular aspects of geometry and measurement
- Setting appropriate benchmarks to build mastery
- Explanations and examples of the Panel's grade-level benchmarks

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Welcome to the overview on Preparing Students for Success in Algebra.

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The mathematics teaching staff from the New Rivers School District held their first K through 12 meeting earlier this year. The purpose was to discuss alignment of mathematics content vertically across the grades. When the teachers reviewed students' progress on major mathematics goals, they discovered a few surprises!

As usual, students in elementary grades performed well on the state's mathematics assessment, with 75% being proficient or greater; but the results for the state's algebra assessment, given last spring, were very disappointing. "How could these be the same students we had before?" asked an elementary teacher.

The three Algebra I teachers, however, were not surprised. They described how most students had struggled last year with algebra. The district math supervisor also explained that the assessments from the earlier grades shouldn't be taken as predictors of how well students will do in algebra because the tests don't adequately address many of the skills that are critical for algebra preparation.

By the end of the meeting, everyone had made a commitment to review the elementary and middle school mathematics curricula and figure out how to better prepare New Rivers' students for algebra. They quickly realized that these challenges were system-wide and could affect standards and benchmarks, curriculum and instruction, assessments, and professional development.

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The National Mathematics Advisory Panel Report makes clear how important it is that all students gain proficiency in algebra. Algebra is a foundation for all higher mathematics. It's a gateway to later achievement in other forms of math that students will encounter in high school and beyond.

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To prepare students for algebra success, the National Mathematics Advisory Panel recommends a focused, coherent progression of key mathematics skills and topics in the elementary and middle years. "Focused" means that the curriculum includes in-depth engagement with the most important topics underlying algebra. "Coherent" implies a logical progression of topics, building upon previous instruction towards a deeper understanding of mathematics.

What is an example of logical progression? Younger children begin working with representations of whole numbers. They then become fluent in applying operations and properties to whole numbers. Later, they use whole numbers to solve equations.

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Developing proficiency in selected mathematics topics is the best preparation for algebra. Students need to: understand key concepts, such as fractions; master basic math facts and competently use standard algorithms like addition and multiplication; and be able to solve problems that require a range of skills and knowledge.

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The National Mathematics Advisory Panel identified three topics that provide a critical foundation for algebra: fluency with whole numbers, proficiency with fractions, and a solid grasp of particular aspects of geometry and measurement.

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Fluency with whole numbers means that students have a strong sense of numbers and operations. As they become fluent, they develop an understanding of place value and the ability to compose and decompose whole numbers. They understand the basic operations and are able to quickly recall arithmetic facts. Students become adept in the concepts underlying commutative, associative, and distributive properties, as well as standard arithmetic algorithms. So, for example, young students learn that in addition, the order of numbers does not matter and that they can group numbers in any way.

Lastly, fluency involves gaining the ability to estimate the results of computations and orders of magnitude. Achieving this proficiency with whole numbers is necessary before students can effectively approach the subject of fractions.

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The second important topic, and perhaps the most critical, is proficiency with fractions. Fractions are essential for algebra and are the least developed conceptually in most U.S. curricula and textbooks.

Developing proficiency in fractions means: being able to represent and compare fractions, decimals, and percents, and understand the relationships among them. This includes being able to work with negative fractions and the ability to locate positive and negative fractions on a number line.

It means being capable of carrying out basic operations with fractions and using them in problems, including those involving rates, proportionality, and probability. All this, of course, requires having whole number fluency.

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Finally, there are some particular aspects of geometry and measurement that are important for algebra preparation, such as the ability to analyze two- and three-dimensional shapes and determine perimeter, area, volume, and surface area. Students must also develop an understanding of proportional relationships, such as those involving similar triangles, as well as be able to find unknown lengths, angles, and areas.

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These three topics make up the critical foundations for algebra. While they do not represent the complete mathematics curriculum for pre-K to grade 8 students, they are essential topics that deserve ample time for in-depth development.

Now that we've explored what "focused and coherent" instruction means, let's look at one of our most powerful tools for building mastery, "benchmarks."

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Benchmarks are the points of mastery for skills—when it is critical that students have developed proficiency in a skill that they may have been working on for several years. They are essential to ensure that students are learning these foundational concepts in a logical progression.

For example, the National Mathematics Panel report recommends these benchmarks for the topic of fractions in the elementary grades: By the end of grade 4, students should be able to identify and represent fractions and decimals and compare them on a number line or with other common representations of fractions and decimals. By the end of grade 5, students should be proficient with comparing fractions and decimals and common percents and with the addition and subtraction of fractions and decimals. By the end of grade 6, students should be proficient with multiplication and division of fractions and decimals and all operations involving positive and negative integers.

A well-honed set of benchmarks, along with assessments, focuses instruction on the essential topics and ensures that each concept leads into the subsequent one. Everyone is guided in the same direction, focused on mastery of the key concepts and skills. A complete list of recommended Benchmarks for Critical Foundations is available in the National Mathematics Panel report and on other parts of this website.

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After a semester of study group sessions, all the teachers from New Rivers elementary and middle schools came to see their roles in a new light; but much work lies ahead of them to align content across the grades, set appropriate benchmarks, refocus instruction, and develop formative assessments. They are already beginning to streamline the number of topics they address and work toward student mastery of pre-algebra topics. It isn't a quick or easy transition, but they're on the right track to better preparing their students for high school algebra.

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For more information on algebra foundations, please see the additional materials on the Doing What Works website.